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(54) Title: METHOD AND APPARATUS FOR MULTIPLEXING A PLURALITY OF DATA CONNECTIONS ONTO ONE TEMPORARY BLOCK FLOW

(57) Abstract: A method and an apparatus are described for sending packet data over a wireless link. The method includes steps of sequentially multiplexing a plurality of radio bearers onto one Temporary Block Flow (TBF) by performing, for a first radio bearer, a step of transmitting the first radio bearer identity to a receiver in at least one first Radio Link Control (RLC) block of a Temporary Block Flow (TBF); upon an occurrence of a change from the first radio bearer to a second radio bearer, transmitting the second radio bearer identity to the receiver in at least one subsequent Radio Link Control (RLC) block of the same TBF; and, at the receiver, sequentially demultiplexing the plurality of radio bearers from the one Temporary Block Flow (TBF) by first detecting the presence of the radio bearer identities in received RLC blocks. An initial step of the method maps a Network Service Access Point Identifier (NSAPI), and thus quality of service parameters, to the radio bearer identities. A further step transmits from the receiver, in response to receiving the second radio bearer identity and if quality of service parameters of the second radio bearer require a new channel allocation, a channel assignment message (e.g., a Packet Uplink Assignment message) to the transmitter. Alternatively, if quality of service parameters of the second radio bearer do not require a new channel allocation, an acknowledgement of the receipt of a first received RLC block from the second radio bearer is transmitted to the transmitter.

METHOD AND APPARATUS FOR MULTIPLEXING A PLURALITY OF DATA CONNECTIONS ONTO ONE TEMPORARY BLOCK FLOW

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FIELD OF THE INVENTION:

This invention relates generally to method and apparatus for transmitting and receiving packet data over a wireless
10 interface and, more particularly, relates to methods and apparatus for transmitting and receiving packet data between a wireless user terminal and a network operator in a digital cellular telecommunications system.

15 ### BACKGROUND OF THE INVENTION:

Modern wireless telecommunications systems are evolving to provide high speed packet data services for users of mobile equipment. One example is an ability to provide internet
20 access to a user of mobile equipment. A wireless system that is rapidly evolving in this direction is a Time Division, Multiple Access (TDMA) system known as the Global System for Mobile Communication (GSM), in particular enhanced versions of GSM known as GSM+, GPRS (General Packet Radio Services) and
25 EGPRS (Enhanced General Packet Radio Services).

The GPRS Release '97 was the first standard to provide (limited) packet data services. However, this standard did not provide a capability for the user to control the bit rate(s)
30 and delays for a packet data connection. In the developing Universal Mobile Telecommunication System (UMTS) packet domain permits several packet data connections to be simultaneously maintained, with different qualities of service. Although there have, at present, been two subsequent GPRS releases
35 since the Release '97, the quality of service concept has

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remained the same.

The Enhanced GPRS (EGPRS) phase 2, which is expected to be the next GPRS release (Release '00), provides a new radio access
5   network to the UMTS core network, and is to adopt the same quality of service attributes as used in the existing UMTS.

A problem thus has arisen, as to how the basic GPRS quality of service provisions can be enhanced to meet the same
10 flexibility requirements that exist in UMTS.

In the UMTS system the data connection between a core network and a mobile station is identified using a Network Service Access Point Identifier (NSAPI), that identifies as well a
15 radio access bearer. In the previous releases of GPRS (pre-Release '00), a connection is identified by NSAPI and a Logical Link Control (LLC) protocol SAPI. However, in UMTS, and thus in GPRS Release '00, the LLC protocol is no longer used.
20
More specifically, in the UMTS a data connection between a mobile station (MS), such as a cellular telephone, and the third generation (3G) Serving GPRS Support Node (SGSN), or 3G-SGSN, is identified using the Network Service Access Point
25 Identifier (NSAPI) with which the requested quality of service parameters are associated. The data connection is realized by a radio access bearer established by the 3G-SGSN to the radio access network. The radio access bearer identity is the same as the NSAPI. In the radio interface the radio access bearer
30 is realized by one or several radio bearers, each having their own identities. During the radio bearer set-up phase the NSAPI is associated with radio bearers and the radio bearers are associated with a channel. As such, in the UMTS radio access

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network the channel number/identifier unambiguously identifies
the data connection and its quality of service parameters and,
hence, there is no need to carry either the NSAPI or radio
bearer identity in protocol headers.

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However, in GPRS Release '00 there is no provision to
associate a data connection to a (physical) channel. As such,
one problem that arises is how to identify a data connection
in the radio interface.

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A second issue relates to improving the flexibility of the
GPRS Radio Link Control/Media Access Control (RLC/MAC) layer.
An important distinction between the basic GPRS and the UMTS
Radio Access Network (URAN) is that the GPRS MAC multiplexes

15 Logical Link (LL) Protocol Data Units (PDUs), while UMTS
multiplexes transport (Radio Link Control or RLC) blocks. In
general, GPRS multiplexing is inflexible, and is not suitable
for connections having different quality of service
requirements. For example, whatever the size of the LL PDU

20 from SAPI 5 in Fig. 2 (the maximum length is 1520 octets), it
must be entirely sent before the layer 3 message from SAPI 1
can be sent. If the RLC mode used by SAPI 5 is different than
the one used for signalling, then the current Temporary Block
Flow (TBF) must be released, and a new TBF established before

25 the layer 3 message can be sent. Before sending a new LL PDU,
a Packet Resource Request message must be sent to the network
to indicate the characteristics (radio priority, peak
throughput class, RLC mode) of the new LL PDU.

30 In EGPRS the same access types as in GPRS are supported to
establish the Temporary Block Flow (TBF) in the uplink
direction (i.e., from the mobile equipment to the network). To
accomplish this, a control message used by a GPRS mobile

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equipment to request a packet channel (Packet Channel Request, 11 bits) is re-used for EGPRS.

To summarize, in GPRS '97 a data connection is identified by
5   the NSAPI carried in a SNDCP (Subnetwork Dependent Convergence Protocol) header and by a LLC SAPI carried in a LLC protocol header. However, in GPRS Release '00 the SNDCP is replaced with Packet Data Convergence Protocol (PDCP) that does not have NSAPI in a protocol header, and the LLC protocol is
10 removed. As such, the GPRS Release '97 type of identification cannot be directly used, while in UMTS the NSAPI is not required to be carried in the protocol header, as the NSAPI/radio bearer/channel mapping is done unambiguously.

15 With regard to multiplexing in UMTS, there are two levels of data multiplexing. First, the MAC multiplexes logical channels onto the transport channel. The basic multiplexing unit is a PDCP PDU, hence MAC multiplexing has the same properties as the LLC PDU multiplexing in a GPRS RLC. For example, and
20 referring to Fig. 3, if radio bearer x has a higher priority than radio bearer y, and if they are multiplexed onto the same transport channel (Dedicated Transport Channel or DCH) 2, then a Packet Data Convergence Protocol (PDCP) Protocol Data Unit (PDU) from the radio bearer x cannot be sent before a previous
25 PDCP PDU from the radio bearer y has been sent. Transport channels are connected to a layer 1 coding and multiplexing unit that processes and multiplexes several dedicated transport channels into a coded composite transport channel (CCTrCH). Bits from the CCTrCH can be mapped on the same
30 physical channel, as shown in Fig. 3. The only restriction is that transport channels should have the same Carrier to Interference (C/I) requirement, therefore both speech and data cannot be mapped onto the same physical channel. Each

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transport channel has its own transport format set. On the physical channel all combinations of transport formats cannot be supported, but only a subset that is defined in the transport format combination set. When mapping data onto a
5   physical channel, MAC chooses between the different transport format combinations given in the transport format combination set. This selection is performed rapidly and utilizes a flexible variable bit rate scheme for the physical layer without requiring additional signalling. If, in Fig. 3, radio
10 bearers x and y are mapped on the different transport channels DCH2 and DCH3, then RLC PDUs from DCH2 can be sent at the same time, or before, RLC PDUs from DCH3, depending on the transport format combination that the MAC transfers to layer 1. However, the total bit rate of the different transport
15 channels cannot exceed at any time the maximum bit rate set of the CCTrCH.

In summary, with the known techniques a data connection is implicitly associated with a Radio Link Control (RLC)
20 Temporary Block Flow (TBF).

To overcome these problems, it has been previously proposed to allow more than one Temporary Block Flow (TBF) to simultaneously exist. However, for several reasons this
25 approach is not optimum.

OBJECTS AND ADVANTAGES OF THE INVENTION:

It is a first object and advantage of this invention to
30 provide a method and apparatus for multiplexing a plurality of data connections, in a flexible manner, into one Radio Link Control (RLC) Temporary Block Flow (TBF).

It is another object and advantage of this invention to employ radio bearer identities to make fast packet channel resource requests.

5   **SUMMARY OF THE INVENTION**

The foregoing and other problems are overcome and the objects of the invention are realized by methods and apparatus in accordance with embodiments of this invention.

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As was made evident above, in UMTS the data connection is identified using the Network Service Access Point Identifier (NSAPI), that also identifies a radio access bearer. In the previous releases of GPRS (pre-Release '00), a connection is
15   identified by NSAPI and a Logical Link Control (LLC) protocol SAPI. However, in UMTS, and thus in GPRS Release '00, the LLC protocol is no longer used. As such, either the NSAPI or the UMTS radio bearer needs to be associated with a GPRS RLC TBF in order to identify a data connection in the radio interface.

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This invention provides a method and apparatus for multiplexing a plurality of radio bearers onto one TBF by utilizing radio bearer identities in the GPRS radio interface. This method and apparatus also provide the benefit of enabling
25   a rapid channel allocation request to occur.

The method unambiguously maps the Network Service Access Point Identifier (NSAPI), and thus the quality of service parameters, to radio bearer identities, and uses a radio
30   bearer identity only once for one mobile station. That is, the same numeric value of the radio bearer identity is not associated with two NSAPIs in the same mobile station. In this method, a radio bearer identity is carried in the Radio Link

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Control (RLC) block, at the beginning of a Temporary Block
Flow (TBF), and every time a radio bearer is changed. A
changed radio bearer identity also functions as a new channel
request, if the quality of service requirements of a new radio
5   bearer are different than the quality of service requirements
of the previous radio bearer. Furthermore, a radio bearer
identity is conveyed in an RLC acknowledgement message from
the receiver to the transmitter or sender of the packet data.

10   The method thus provides for a radio bearer identity, or
RB_id, to be carried in each RLC data block, or at the
beginning of the TBF. This can be accomplished, in a preferred
embodiment of this invention, utilizing packet flow identifier
bits first introduced for GPRS Release '99.
15   A method is herein disclosed for sending packet data over a
wireless link. The method includes steps of sequentially
multiplexing a plurality of radio bearers onto one Temporary
Block Flow (TBF) by performing, for a first radio bearer, a
step of transmitting the first radio bearer identity to a
20   receiver in at least one first Radio Link Control (RLC) block
of a Temporary Block Flow (TBF); upon an occurrence of a
change from the first radio bearer to a second radio bearer,
transmitting the second radio bearer identity to the receiver
in at least one subsequent Radio Link Control (RLC) block of
25   the same TBF; and, at the receiver, sequentially
demultiplexing the plurality of radio bearers from the one
Temporary Block Flow (TBF) by first detecting the presence of
the radio bearer identities in received RLC blocks.

30   An initial step of the method maps a Network Service Access
Point Identifier (NSAPI), and thus quality of service
parameters, to the radio bearer identities.

A further step transmits from the receiver, in response to receiving the second radio bearer identity and if quality of service parameters of the second radio bearer require a new channel allocation, a Packet Uplink Assignment message (or
5 some other suitable channel assignment message) to the transmitter. Alternatively, if quality of service parameters of the second radio bearer do not require a new channel allocation, an acknowledgement of the receipt of a first received RLC block from the second radio bearer is transmitted
10 to the transmitter.

In the presently preferred, but not limiting, GPRS embodiment, the radio bearer identity is preferably contained within packet flow identifier (PFI) bits, and the presence of the
15 radio bearer identity within the PFI bits is indicated by using a PFI Indicator (PI) bit.

A further step of the method is executed upon an occurrence of a change from the second radio bearer to the first or to
20 another radio bearer, by transmitting the radio bearer identity of the first radio bearer or the other radio bearer to the receiver in another subsequent Radio Link Control (RLC) block of the same TBF. The receiver may then perform a step of acknowledging the receipt of the another subsequent Radio Link
25 Control (RLC) block by transmitting a Packet Uplink Ack message or a Packet Downlink Ack message from the receiver to the transmitter.

Note should thus be made of the fact that the teachings of
30 this invention apply as well to the downlink, although in the downlink direction the channel allocation procedure does not differ from the current allocation procedure. However, the change in radio bearer is preferably acknowledged using a

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Packet Downlink Acknowledgement message from the mobile station to the network.

BRIEF DESCRIPTION OF THE DRAWINGS

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The above set forth and other features of the invention are made more apparent in the ensuing Detailed Description of the Invention when read in conjunction with the attached Drawings, wherein:

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Fig. 1 is a simplified block diagram of telecommunications system that is suitable for practicing this invention;

Fig. 2 illustrates a conventional GPRS multiplexing principle, 15 where GMM is a GPRS Mobility Management protocol;

Fig. 3 illustrates a conventional UMTS multiplexing principle;

Fig. 4 is a logical block diagram depicting the mapping or 20 multiplexing of two radio bearers onto the same Temporary Block Flow (TBF) at a transmitter;

Fig. 5 is a logical block diagram depicting the demultiplexing of two radio bearers from the same Temporary Block Flow (TBF), 25 using radio bearer identity (RB_id), at a receiver;

Fig. 6 shows a method of using radio bearer identities to make fast packet channel resource requests; and

30 Figs. 7A-7E depict formats for various uplink RLC data blocks.

DETAILED DESCRIPTION OF THE INVENTION

In order to improve the multiplexing capabilities of the GPRS
Radio Link Control (RLC), Media Access Control (MAC) layer,
the Network Service Access Point Identifier (NSAPI) must be
5   able to be identified within a RLC block. As such, the NSAPI
is associated with the radio bearer identity. This association
is performed using a radio resource control protocol between
the network and the mobile station.

10 Referring to Fig. 4, for each radio bearer there is an RLC
entity 10 that manages control functions, such as
segmentation, reassembly and acknowledgements, that are
related to the radio bearer. The MAC 12 is provided with a
multiplexing functional element (FE) 14 that multiplexes
15 different radio bearers onto the same TBF. In the transmitter
1, or sending side, the multiplexing FE 14 adds a radio bearer
identification (RB_id) to each RLC block, or to the first RLC
block of a TBF. If only one radio bearer is currently in use,
then the RB_id is only added to the first RLC of the TBF. The
20 multiplexing FE 14 multiplexes RLC Protocol Data Units (PDUs)
from different radio bearers onto the TBF depending on the
priorities of the radio bearers or, more generally, depending
on the quality of service attributes of the radio bearers.
Also shown in Fig. 4, associated with each RLC 10, are
25 respective Packet Data Convergence Protocol (PDCP) units 18,
IP core protocols 20, Radio Resource Control (RRC) unit 22,
and a Radio Link Control for control plane (RLC-C) unit 24.

At the receiver 2, or receiving side, depicted in Fig. 5 the
30 different radio bearers are demultiplexed by a demultiplexing
Radio Link Control unit 28, using the received radio bearer
identities (RB_ids). The RB_id can be defined using Packet
Flow Identifier (PFI) bits, and the presence of the radio

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bearer identity may be indicated using the PFI Indicator (PI) bit. The RB identity fields define the radio bearer that the RLC block is associated with. If a RB_id is not present in the RLC data block, the RLC-U (RLC user plane part) demultiplexer

5   block 30 assumes that all RLC blocks within the TBF belong to the previous radio bearer that was identified by the RB_id.

In the EGPRS case the radio bearer identity can also be defined using packet flow identifier (PFI) bits, and the

10 presence of the radio bearer identity may be indicated using the PFI Indicator (PI) bit.

Figs. 7A-7E depict various uplink RLC data block formats showing locations of PFI and PI bit fields. A similar scheme

15 for coding RB_id in the downlink may be employed. In Figs. 7C, 7D and 7E the abbreviation "MCS" stands for Modulation and Coding Scheme.

Since there is an RLC entity for each radio bearer the

20 acknowledgement messages are also modified from those originally defined in GPRS '97. A radio bearer to which a particular acknowledgement is associated may be defined using an Extension Bits information element in a Packet Downlink Ack/Nack message and in a Packet Uplink Ack/Nack message.

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Fig. 6 illustrates a method showing how radio bearer identities can be used to make fast packet channel resource requests. At Step A a first RLC block is sent in a TBF. In this case the RLC block belongs to radio bearer 1. In the

30 following RLC blocks (Step B) the radio bearer identity is not included, until an RLC block from another radio bearer is required to be sent (Step C). In order to avoid a malfunction in the acknowledgements, the network acknowledges the change

in the radio bearer. In Step D the quality of service parameters of radio bearer 2 are assumed to require a new channel allocation, hence a Packet Uplink Assignment message confirms to the sender that the radio bearer has been
5   successfully changed. If a new channel allocation is not required, then the network instead acknowledges the first received RLC block from the new radio bearer (radio bearer 2). In Step E an RLC block from radio bearer 2 is transmitted, and no RB_id is required to be included. In Step F the radio
10 bearer is again changed (to radio bearer 1), and this time the network confirms the change by immediately acknowledging the first received RLC block from radio bearer 1.

Referring to Fig. 1, there is illustrated a simplified block
15 diagram of an embodiment of a wireless communications system 5, suitable for practicing this invention, that includes a plurality of mobile stations 100. Two mobile stations (MSs) are shown in Fig. 1, with one being designated MS#1 and the other MS#2. Fig. 1 also shows an exemplary network operator
20 having, for example, a GPRS Support Node (GSN) 30 for connecting to a telecommunications network, such as the Public Packet Data Network or PDN, at least one base station controller (BSC) 40, and a plurality of base transceiver stations (BTS) 50 that transmit in a forward or downlink
25 direction both physical and logical channels to the mobile stations 100 in accordance with a predetermined air interface standard. A reverse or uplink communication path also exists from the mobile station 100 to the network operator, which conveys mobile originated access requests and traffic,
30 including the RLC data blocks in accordance with the teachings herein.

In a preferred, but not limiting, embodiment of these

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teachings, the air interface standard can conform to any
standard that enables packet data transmissions to occur with
the mobile stations 100, such as Internet 70 access and web
page downloads. In the presently preferred embodiment of this
5   invention the air interface standard is a Time Division
Multiple Access (TDMA) air interface that supports the
enhanced GPRS capabilities disclosed herein.

The network operator may also include a Message Service Center
10   (MSC) 60 that receives and forwards messages for the mobile
stations 100, although any wireless messaging technique that
is capable of using packet data can be used. Other types of
messaging service may include Supplementary Data Services and
one under currently development and known as Multimedia
15   Messaging Service (MMS), wherein image messages, video
messages, audio messages, text messages, executables and the
like, and combinations thereof, can be transferred between a
network and a mobile station.

20   The mobile station 100 typically includes a microcontrol unit
(MCU) 120 having an output coupled to an input of a display
140 and an input coupled to an output of a keyboard or keypad
160. The mobile station 100 may be considered to be a handheld
radiotelephone, such as a cellular telephone or a personal
25   communicator. The mobile station 100 could also be contained
within a card or module that is connected during use to
another device. For example, the mobile station 10 could be
contained within a PCMCIA or similar type of card or module
that is installed during use within a portable data processor,
30   such as a laptop or notebook computer, or even a computer that
is wearable by the user.

The MCU 120 is assumed to include or be coupled to some type
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of a memory 130, including a read-only memory (ROM) for storing an operating program, as well as a random access memory (RAM) for temporarily storing required data, scratchpad memory, received packet data, packet data to be transmitted,

5   and the like. A separate, removable SIM (not shown) can be provided as well, the SIM storing, for example, a preferred Public Land Mobile Network (PLMN) list and other subscriber-related information. The ROM is assumed, for the purposes of this invention, to store a program enabling the MCU 120 to

10   execute the software routines, layers and protocols required to implement the transmission and reception of packet data in accordance with the teachings herein, as well as to provide a suitable user interface (UI), via display 140 and keypad 160, with a user. Although not shown, a microphone and speaker are

15   typically provided for enabling the user to conduct voice calls in a conventional manner.

The mobile station 100 also contains a wireless section that includes a digital signal processor (DSP) 180, or equivalent

20   high speed processor, as well as a wireless transceiver comprised of a transmitter 200 and a receiver 220, both of which are coupled to an antenna 240 for communication with the network operator. Packet data is transmitted and received through the antenna 240, in accordance with the teachings

25   herein.

Based on the foregoing description, it can be appreciated that the inventor has provided a method and apparatus for multiplexing a plurality of radio bearers onto one TBF by

30   utilizing the radio bearer identities (RB_ids) in the GPRS radio interface. The disclosed method and apparatus also provide the benefit of enabling a rapid channel allocation request to occur.

Those skilled in the art may derive various modifications to
these techniques, when guided by the teachings herein. For
example, it may be desirable to include the RB_id in multiple
5   RLC blocks until the receiving end either acknowledges, or
sends a channel allocation. This technique can be employed to
improve the overall reliability when changing radio bearers.

Thus, while the invention has been particularly shown and
10 described with respect to preferred embodiments thereof, it
will be understood by those skilled in the art that changes in
form and details may be made therein without departing from
the scope and spirit of the invention.

15

CLAIMS

What is claimed is:

1. A method for multiplexing a plurality of radio bearers onto one Temporary Block Flow (TBF), comprising steps of:

for a first radio bearer, transmitting the first radio bearer identity to a receiver in at least one Radio Link Control (RLC) block of a Temporary Block Flow (TBF); and

upon an occurrence of a change from the first radio bearer to a second radio bearer, transmitting the second radio bearer identity to the receiver in at least one subsequent Radio Link Control (RLC) block of the same TBF.

2. A method as in claim 1, and comprising an initial step of mapping a Network Service Access Point Identifier (NSAPI), and thus quality of service parameters, to the radio bearer identities.

3. A method as in claim 1, and comprising a further step of transmitting from the receiver, in response to receiving the second radio bearer identity, and if quality of service parameters of the second radio bearer require a new channel allocation, a channel assignment message to the transmitter.

4. A method as in claim 1, and comprising a further step of transmitting from the receiver, in response to receiving the second radio bearer identity, and if quality of service parameters of the second radio bearer do not require a new channel allocation, an acknowledgement of the receipt of a

first received RLC block from the second radio bearer.

5. A method as in claim 1, wherein the radio bearer identity is contained within packet flow identifier (PFI) bits, and the presence of the radio bearer identity within the PFI bits is signalled by using a PFI Indicator (PI) bit.

6. A method as in claim 3, wherein the channel assignment message comprises a Packet Uplink Assignment message.

7. Apparatus for transmitting packet data, comprising a multiplexer for multiplexing a plurality of radio bearers onto one Temporary Block Flow (TBF), and further comprising, for a first radio bearer, a unit for transmitting the first radio bearer identity to a receiver of the packet data in at least one Radio Link Control (RLC) block of a Temporary Block Flow (TBF), said unit being responsive to an occurrence of a change from the first radio bearer to a second radio bearer, for transmitting the second radio bearer identity to the receiver in at least one subsequent Radio Link Control (RLC) block of the same TBF.

8. Apparatus as in claim 7, wherein a Network Service Access Point Identifier (NSAPI), and thus quality of service parameters, are mapped to the radio bearer identities.

9. Apparatus as in claim 7, wherein said receiver comprises a demultiplexer that is responsive to a receipt of said radio bearer identities for demultiplexing RLC blocks from the TBF, and further comprising a unit, responsive to a receipt of the second radio bearer identity, and if quality of service parameters of the second radio bearer require a new channel allocation, for sending a channel assignment message

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to the transmitter.

10. Apparatus as in claim 7, wherein said receiver comprises a demultiplexer that is responsive to a receipt of said radio bearer identities for demultiplexing RLC blocks from the TBF, and further comprising a unit, responsive to a receipt of the second radio bearer identity, and if quality of service parameters of the second radio bearer do not require a new channel allocation, for sending to the transmitter an acknowledgement of the receipt of a first received RLC block from the second radio bearer.

11. Apparatus as in claim 7, wherein the radio bearer identity is contained within packet flow identifier (PFI) bits in the RLC data block, and wherein the presence of the radio bearer identity within the PFI bits is signalled by using a PFI Indicator (PI) bit.

12. Apparatus as in claim 9, wherein the channel assignment message comprises a Packet Uplink Assignment message.

13. A method for sending packet data over a wireless link, comprising:

sequentially multiplexing a plurality of radio bearers onto one Temporary Block Flow (TBF) by executing steps of,

for a first radio bearer, transmitting the first radio bearer identity to a receiver in at least one Radio Link Control (RLC) block of a Temporary Block Flow (TBF);

upon an occurrence of a change from the first radio bearer to a second radio bearer, transmitting the second radio bearer identity to the receiver in at least one subsequent RLC block of the same TBF; and

at the receiver, sequentially demultiplexing the plurality of radio bearers from the one Temporary Block Flow (TBF) by first detecting the presence of the radio bearer identities in received RLC blocks.

14. A method as in claim 13, comprising an initial step of mapping a Network Service Access Point Identifier (NSAPI), and thus quality of service parameters, to the radio bearer identities.

15. A method as in claim 13, and comprising a further step of transmitting from the receiver, in response to receiving the second radio bearer identity, and if quality of service parameters of the second radio bearer require a new channel allocation, a channel assignment message to the transmitter.

16. A method as in claim 13, and comprising a further step of transmitting from the receiver, in response to receiving the second radio bearer identity, and if quality of service parameters of the second radio bearer do not require a new channel allocation, an acknowledgement of the receipt of a first received RLC block from the second radio bearer.

17. A method as in claim 13, wherein the radio bearer identity is contained within packet flow identifier (PFI) bits, and wherein the presence of the radio bearer identity within the PFI bits is indicated by using a PFI Indicator (PI)

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bit.

18. A method as in claim 13, wherein the step of
multiplexing occurs in a Media Access Control (MAC) layer.

19. A method as in claim 13, further comprising a step
of:

upon an occurrence of a change from the second radio
bearer to the first or another radio bearer, transmitting
the radio bearer identity of the first radio bearer or
the other radio bearer to the receiver in at least one
other subsequent Radio Link Control (RLC) block of the
same TBF.

20. A method as in claim 19, and further comprising a
step of acknowledging the receipt of the at least one other
subsequent Radio Link Control (RLC) block by transmitting an
acknowledgement message from the receiver to the transmitter.

21. A method for sending packet data over a radio
channel, comprising steps of:

establishing a Temporary Block Flow (TBF) between a
mobile station and a network operator; and

for a first radio bearer of the mobile station,
transmitting the first radio bearer identity to a
receiver of the network operator in at least one Radio
Link Control (RLC) block of the established Temporary
Block Flow (TBF).

22. A method as in claim 21, and further comprising a step of:

upon an occurrence of a change from the first radio bearer to a second radio bearer, transmitting the second radio bearer identity to the receiver in a subsequent Radio Link Control (RLC) block of the same TBF.
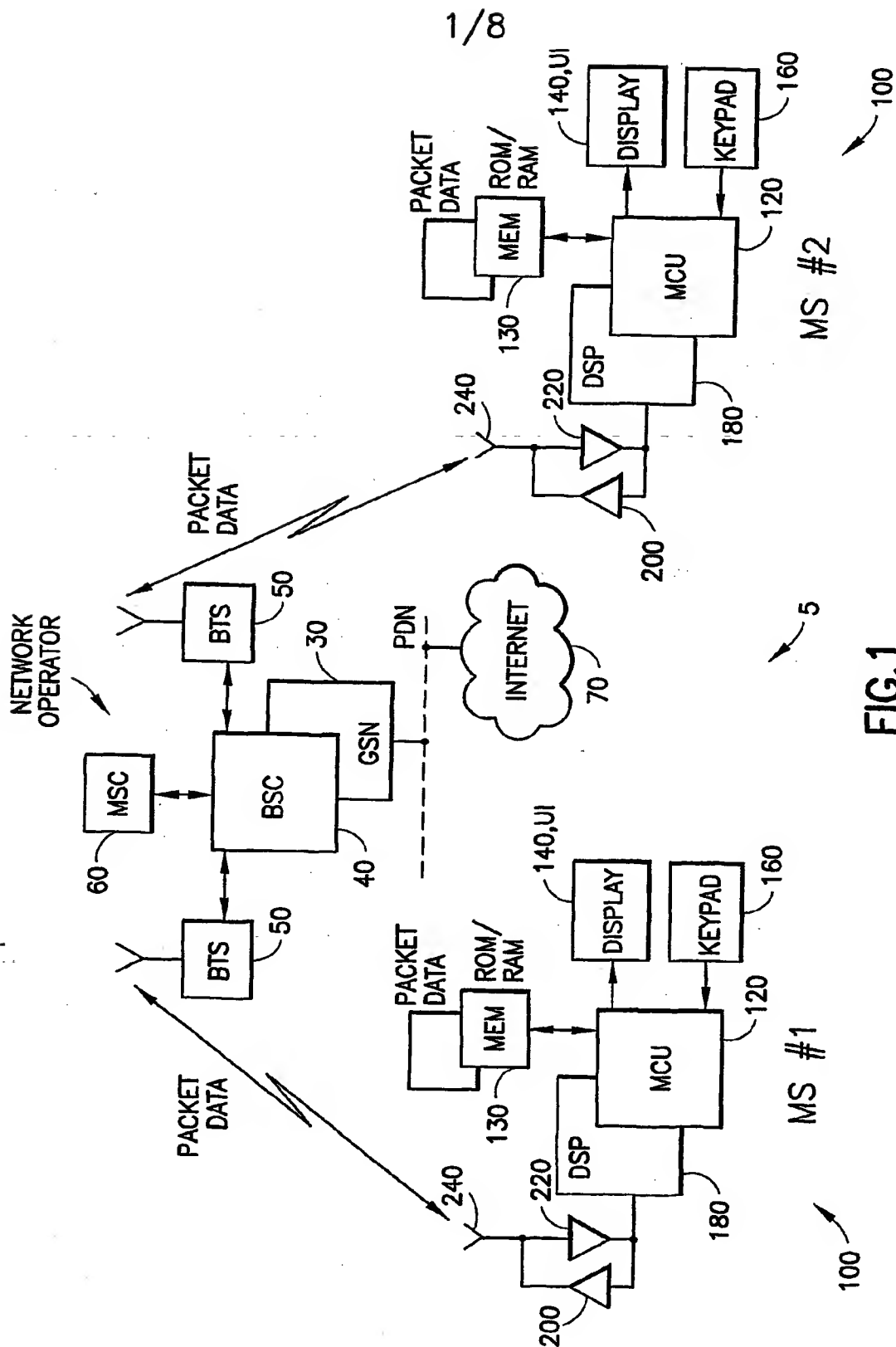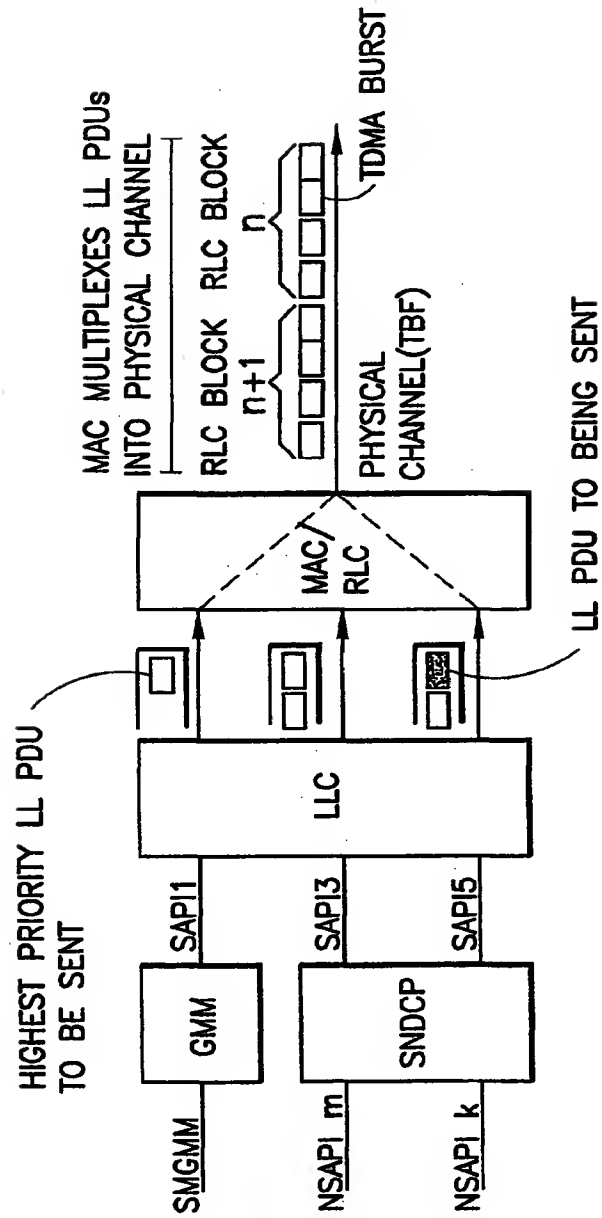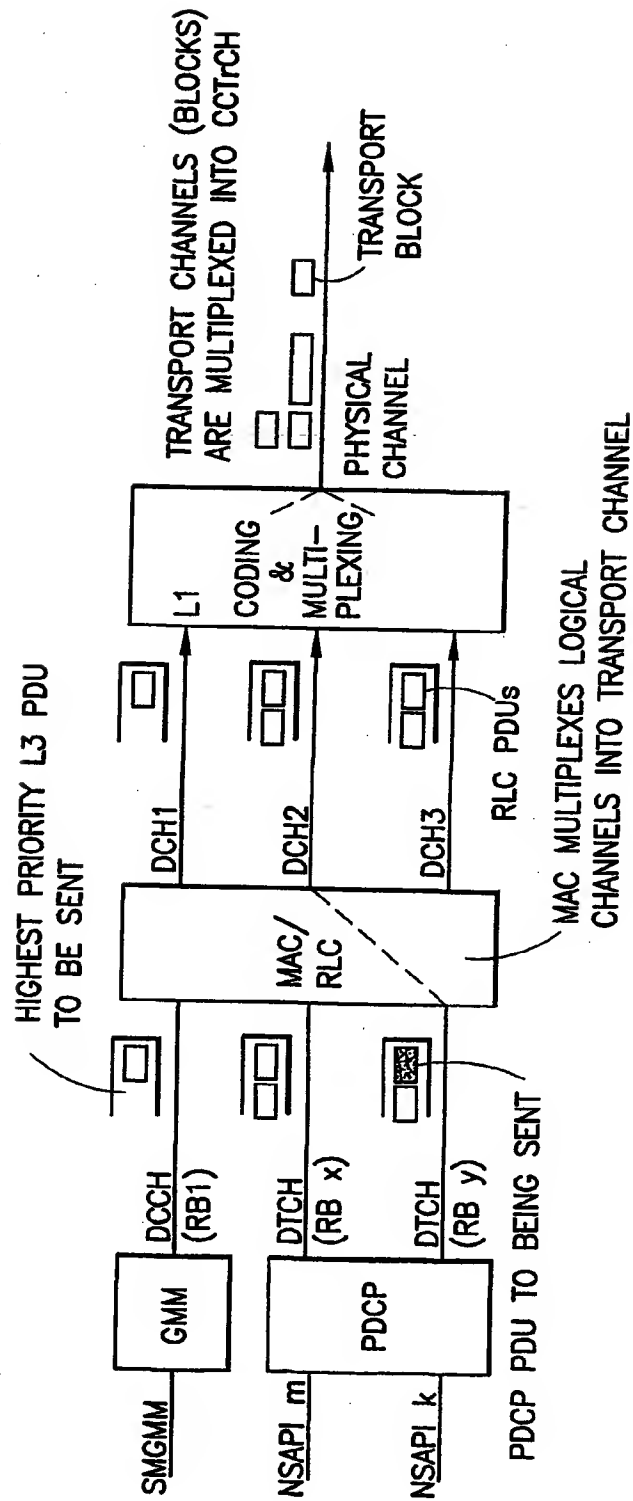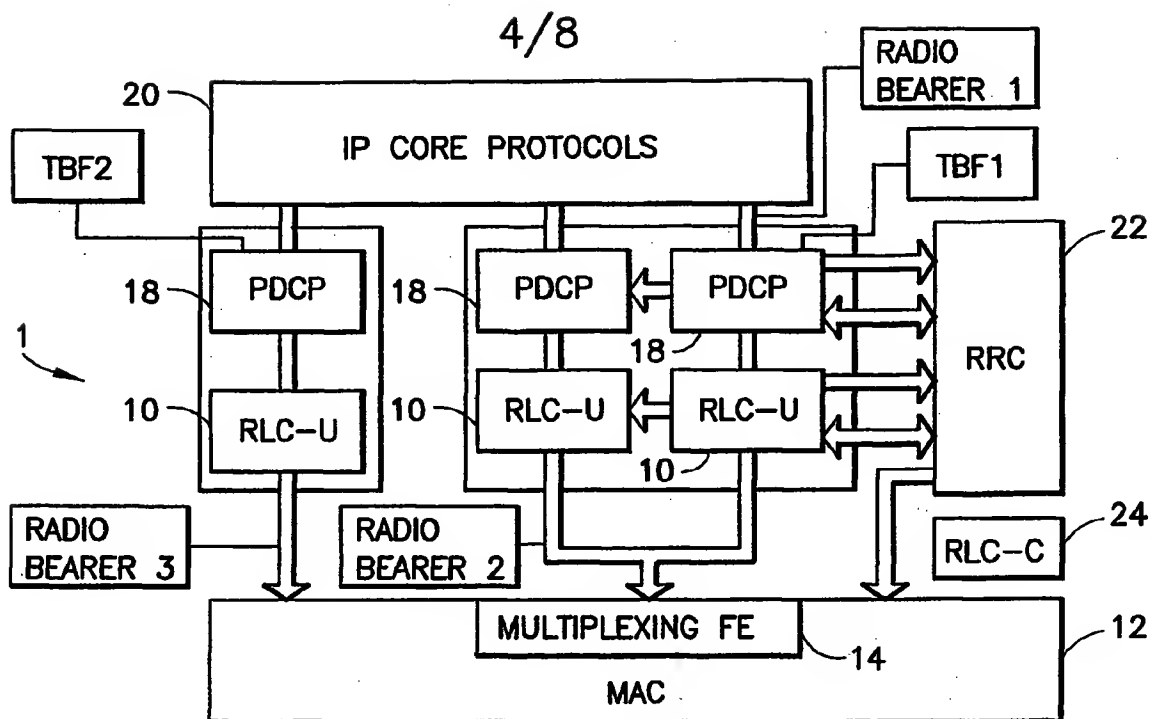
FIG.1

FIG.2
PRIOR ART

FIG.3
PRIOR ART

FIG.4

FIG.5

FIG.6

6/8

BIT

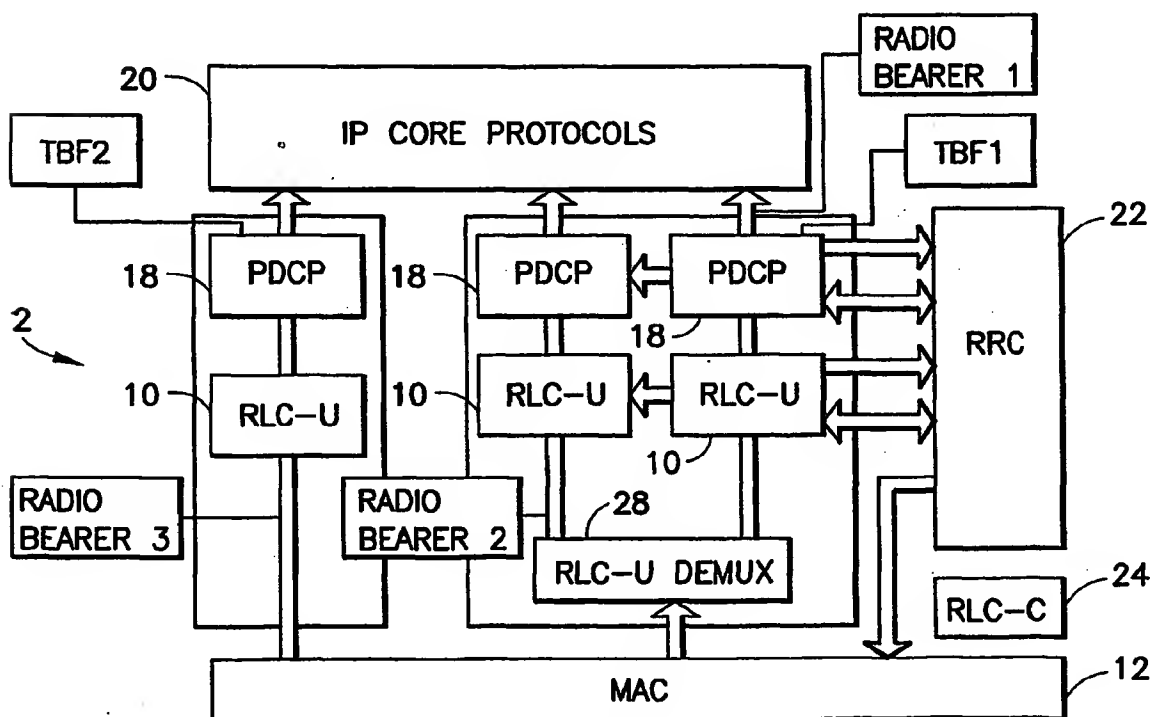| 8	7	6	5	4	3	2	1	
PAYLOAD TYPE		COUNTDOWN VALUE				SI	R	MAC HEADER
SPARE	PI	TFI					TI	OCTET 1
BSN							E	OCTET 2
LENGTH INDICATOR						M	E	OCTET 3 (OPTIONAL)
⋮								⋮
LENGTH INDICATOR						M	E	OCTET M (OPTIONAL)
TLLI								OCTET M+1 \ OCTET M+2 } (OPTIONAL) OCTET M+3 / OCTET M+4 /
PFI								OCTET M+5 /
RLC DATA								OCTET M+6 (M+1 IF NO TLLI) ⋮ OCTET N-1 OCTET N (IF PRESENT)

SPARE   SPARE
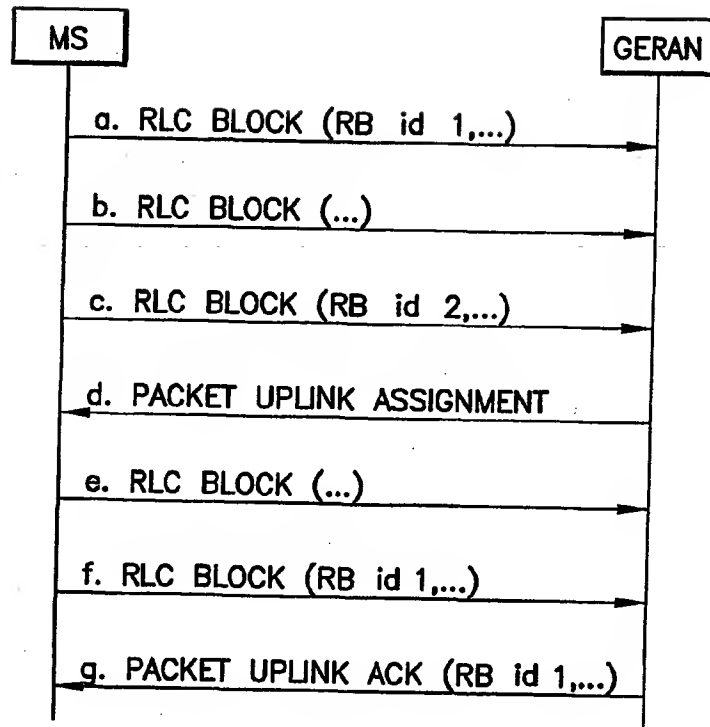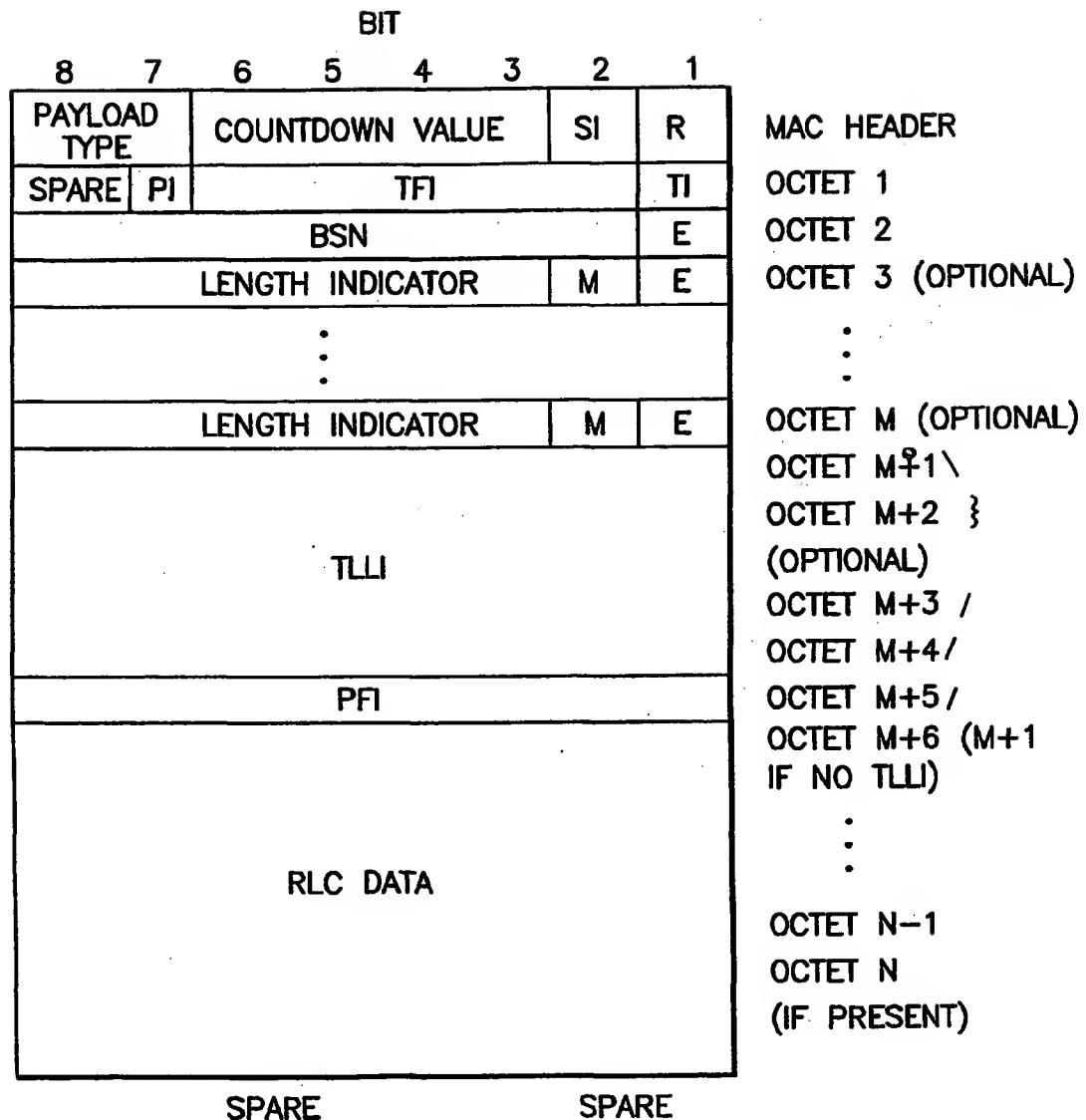
GPRS UPLINK RLC DATA BLOCK WITH MAC HEADER

FIG.7A

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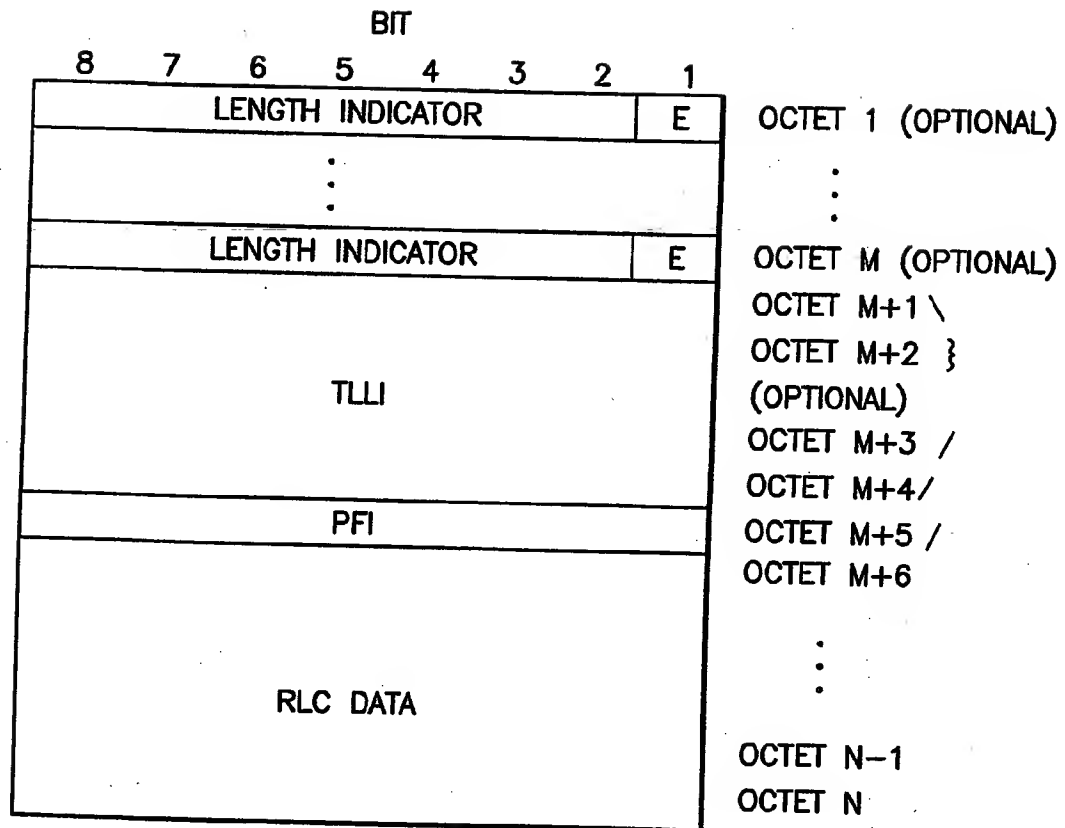
EGPRS UPLINK RLC DATA BLOCK

FIG.7B

BIT

8	7	6	5	4	3	2	1
TFI		COUNTDOWN VALUE				SI	R
BSN1					TFI		
BSN2		BSN1					
BSN2							
SPARE		RSB	CPS				
		SPARE					PI

UPLINK RLC DATA BLOCK HEADER FOR MCS-7, MCS-8 AND MSC-9.

FIG.7C

BIT

8	7	6	5	4	3	2	1
TFI		COUNTDOWN VALUE				SI	R
BSN1					TFI		
CPS		BSN1					
SPARE							CPS
		SPARE					PI

UPLINK RLC DATA BLOCK HEADER FOR MCS-5 AND MSC-6.

FIG.7D

BIT

8	7	6	5	4	3	2	1
TFI		COUNTDOWN VALUE				SI	R
BSN1					TFI		
CPS		BSN1					
	SPARE	PI	RSB	SPB		CPS	

UPLINK RLC DATA BLOCK HEADER FOR MCS-1, MCS-2, MCS-3 AND MSC-4.

FIG.7E

INTERNATIONAL SEARCH REPORT

Inter   nal Application No
PC'⌐/⌐B 01/00684

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7   H04Q7/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7   H04Q

Documentation searched other then minimum documentation

Electronic data base consulted during the international search (name of date base and, where practical, search terms used)

EPO-Internal, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 99 16264 A (ERICSSON TELEFON AB L M) 1 April 1999 (1999-04-01) page 7, line 29 -page 8, line 7 figure 6	1,7,13, 21,22
A	EP 0 932 318 A (ITALTEL SPA) 28 July 1999 (1999-07-28) column 3, line 45 -column 4, line 53 figure 5	1,7,13, 21
A	WO 99 39528 A (NOKIA TELECOMMUNICATIONS OY ;VIALEN JUKKA (FI); BRITSCHGI JUHANA ()) 5 August 1999 (1999-08-05) page 12, line 34 -page 14, line 23 figure 4A	1,7,13, 21

☐ Further documents are listed in the continuation of box C.   ☒ Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 October 2001	30/10/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Larcinese, A

Form PCT/ISA/210 (second sheet) (July 1992)

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			EP	1051870 A1	15-11-2000
			WO	9939528 A1	05-08-1999